

4/p.r.b

10/553959
JC12 Rec'd PCT/PTC 19 OCT 2005

SPECIFICATION

VALVE MOUNT HEATER UNIT

5 Technical Field

The present invention relates to a valve mount heater unit to be mounted on a valve connected to a fluid piping system through joints.

10 Background Art

For a valve mounted on a piping system that supplies gas to semiconductor manufacturing equipment or the like, it is necessary to prevent formation of dew condensation within the valve due to a temperature drop in the gas as it passes through the valve. In addition, a valve mounted on a piping system that carries liquid that solidifies at a temperature near room temperature, it is necessary to prevent a blockage of the valve or development of accretion within the valve due to solidification of the liquid. Still further, for a piping system that carries high temperature gas or liquid, a temperature drop in the fluid to be carried through the piping system as the fluid passes through the valve is a problem when the fluid needs to be carried through the piping system without any appreciable temperature drop.

In order to prevent these problems, different types of heating mechanisms, which are built in or attached to a fluid valve, for heating the area within the valve where the fluid passes and the like have been proposed as described, for example, in Japanese Unexamined Patent Publication No. 7 (1995)-71648, Japanese Unexamined Patent Publication No. 2001-349486, and PCT Japanese Publication No. 10(1998)-502995.

The problem of dew condensation, development of accretion and the like, however, may occur not only in the valve section but also in the joint sections connecting the valve to a piping system. The conventional valve heating mechanisms, however, are either built in the valve or mounted only on the valve. Consequently, heretofore,

additional heaters have been required for mounting on the joint sections.

The situation in which separate heating mechanisms are required for the valve and joint sections creates a problem of unequal
5 heating between the flow paths within the valve and joints, as well as problems of increased cost and complicated configuration of the piping system.

In view of the circumstances described above, it is an object of the present invention to provide a heating mechanism capable of
10 heating not only a valve connected to a fluid piping system through joints but also the joints integrally and uniformly.

Disclosure of Invention

The valve mount heater unit of the present invention is a valve
15 mount heater unit to be mounted on a valve connected to a fluid piping system through joints, the unit comprising:

a main body constructed in the form of a housing having pipe through-holes and an actuator exposing opening, and covers flow path forming sections of the valve and joints; and

20 a heater built in the main body,
wherein the heater comprises:

a direct heating section for heating at least a part of the flow path forming sections of the valve through direct contact heating; and

25 a radiant heating section for heating the inside of the main body by radiant heat.

Here, in the valve mount heater unit described above, the valve may be a two-way valve, which is placed between a pair of pipes disposed linearly, and connected to the pipes through a pair of
30 joints; the main body may comprise a pair of housing halves which are fitted together with the valve connected to the pair of pipes being sandwiched therebetween from both sides of the pair of pipes; the pipe through-holes and the actuator exposing opening may be formed by fitting together a plurality of cutouts provided on the
35 edges of each of the housing halves; the heater may comprise flat

panel heaters, each installed inside of each of the pair of housing halves such that the flat panel heaters face with each other across the valve when the pair of housing halves is fitted together; and the direct heating section and radiant heating section may be provided on each of the opposing surfaces of the flat panel heaters. Here, it is preferable that the direct heating section is provided on each of the opposing surfaces of the flat panel heaters at the same position as the actuator exposing opening in the longitudinal direction of the pair of the pipes, and the radiant heating section is provided around the direct heating section.

The valve mount heater unit of the present invention comprises the main body constructed in the form of a housing and covers the flow path forming sections of the valve and joints, and the entire region covered by the main body is heated by the combination of the direct and radiant heating. This allows the entire flow path included in the flow path forming sections of the valve and joints to be heated integrally and uniformly. Further, separate heaters for mounting on the valve and joints are not required, resulting in cost reduction and simplified piping structure.

Further, the valve mount heater unit of the present invention comprises the direct heating sections for heating at least a part of the flow path forming sections of the valve by direct contact heating. If the direct heating sections are arranged such that they contact the region of the flow path forming sections where the temperature is likely to drop significantly, the effect of the uniform heating may be further enhanced. For example, by disposing the direct heating sections adjacent to the actuator exposing opening provided on the main body of the heater unit, and heating through the direct contact heating the area which is likely to be more influenced by the heat loss through the exposed portion of the actuator, the heat loss may be compensated for and uniform heating may be realized.

Still further, in the valve mount heater unit of the present invention, the area of the flow path forming sections of the valve and joints covered by the main body other than that which is brought

into direct contact with the direct heating sections is heated by the radiant heat. This allows certain flow path forming sections which are, for example, difficult to bring into direct contact with the direct heating sections due to their configurations, or direct
5 contact of the sections with the direct contact heating sections may interfere valve operation due to frictions or the like, joints having a hexagonal nut-shape, and the like may be heated effectively and uniformly by the radiant heat radiated from the radiant heating sections.

10

Brief Description of Drawings

Figure 1 is a perspective view of a heater unit having a main body that includes a pair of housing halves according to an embodiment of the present invention, illustrating the heater unit being opened.

15

Figure 2 is a perspective view of the heater unit shown in Figure 1, illustrating the heater unit being closed.

Figure 3 is a perspective view of an illustrative valve connected to a fluid piping system through joints.

Figure 4 is a front view of the valve shown in Figure 3.

20

Figure 5 is a front view of the valve shown in Figure 3 with the heater unit shown in Figure 1 being mounted thereon.

Figure 6 is a side view of the valve shown in Figure 3 with the heater unit shown in Figure 1 being mounted thereon.

25

Best Mode for Carrying Out the Invention

Hereinafter an illustrative embodiment of the present invention will be described in detail with reference to the accompanying drawings. In each of the drawings, identical components are given the same reference numerals.

30

Figure 1 is a perspective view of a heater unit 10 according to an embodiment of the present invention illustrating the main body of the unit comprising a pair of housing halves 12, 14 being opened. Each of the pair of housing halves has a built-in ceramic heater 16 along the side wall. Each of the ceramic heaters 16 generates
35 heat when a current is flowed through a lead wire 18 whose both ends

are drawn outside. A stainless panel is attached to the inner surface of the ceramic heater 16, forming a flat panel heater. The flat panel heater has a recessed portion 20 at the top to receive the lower portion of the actuator of a valve to be described later. A heat
5 insulating material (not shown) is inserted between the ceramic heater 16 and outer wall of each of the housing halves 12, 14 in order to prevent heat loss arising from the outer wall of the main body becoming hot. Another stainless plate is provided on the surface of the stainless panel attached to the inner surface of the ceramic
10 heater 16 below the recessed portion 20, forming a direct heating section 22. The area other than that where the direct heating section 22 is provided on the surface of the stainless panel attached to the inner surface of the ceramic heater 16 forms a radiant heating section 24. A wire indicated by the reference numeral 26 is the wire
15 of a thermocouple that monitors the temperature of the ceramic heaters 16. The housing half 12 has four brackets 28, each with a screw hole, and the housing half 14 has four screw holes in order to fit the housing halves together.

Figure 2 is a perspective view of the heater unit 10 shown
20 in Figure 1, illustrating the housing halves 12, 14 being closed by fitting each screw hole of each of the brackets 28 and each of the corresponding screw holes 30 together, and fixing them with a fixing screw 32. When the heater unit 10 is closed in the manner as described above, two pipe through-holes 34 are formed on the
25 opposite sides, and an actuator exposing opening 36 is formed on the top surface. The actuator exposing opening 36 is formed at the place corresponding to the recessed portions 20 for receiving the lower portion of the actuator. When the heater unit 10 is in the closed state, the direct heating sections 22, and the radiant heating
30 sections 24 in the respective housing halves 12, 14 are facing with each other in parallel and symmetrically.

Figures 3 and 4 respectively show an illustrative valve connected to a fluid piping system. Figure 3 is a perspective view thereof, and Figure 4 is a front view thereof. The entire valve is
35 indicated by the reference numeral 40, which is constituted by a

body 42, a diaphragm case 44 having a diaphragm mechanism therein, an actuator 46, and a pair of connecting sections 48. Each of the connecting sections 48 is connected to a piping system 54 through a hexagonal nut-shaped joint 50 and a sleeve 52. The hatched portion
5 in Figure 4 indicates the flow path. When the valve 40 is opened, a fluid flows from one of the connecting sections 48 to the opposite connecting section 48 through the body 42, the diaphragm case 44, again through the body 42. Thus, these sections are referred to as the flow path forming sections of the valve.

10 Figures 5 and 6 respectively show the valve 40 shown in Figure 3 with the heater unit 10 being mounted thereon. Figure 5 is a front view thereof viewed from the direction indicated by the arrow V in Figure 2. Figure 6 is a side view thereof when viewed from the direction indicated by the arrow VI in Figure 2. As shown in the
15 drawings, the main body of the heater unit 10 comprising a pair of housing halves 12, 14 covers from the lower portion of the actuator 46, through diaphragm case 44 disposed therebelow, to the entire body 42 of the valve 40 in the vertical direction. The upper portion of the actuator 46 protrudes from the actuator exposing opening 36.
20 The lower portion of the actuator 46 and diaphragm case 44 are accommodated in the recessed portions 20. In the mean time, as for the horizontal direction, the main body of the heater unit 10 covers from a part of one of the sleeves 52 to a part of the other sleeve 52. Here, each of the pipe through-holes 34 has a diameter that fits
25 with each of the sleeves 52. By the configuration described above, the pair of joints 50 and entire flow path forming sections of the valve 40 are covered by the main body of the heater unit 10. In addition, the pair of direct heating sections 22 within the heater unit 10 comes in direct contact with the body 42 from both sides of the valve
30 40.

The operation of the heater unit 10 will be described herein below when the heater unit 10 is mounted on the valve 40 as shown in Figures 5 and 6, and the ceramic heaters 16 are activated by flowing a current through the lead wire 18.

35 When the ceramic heaters 16 are activated, both the direct

heating sections 22 and radiant heating sections 24 are heated. The body 42 of the valve 40 is heated by the direct heating sections 22 through direct contact heating. The reason for heating the body 42 through the heat effective direct contact heating is that the
5 body 42 is disposed under the actuator 46 whose upper portion above the actuator exposing opening 36 is exposed, and the temperature of the body 42 is likely to drop due to the heat radiation from the actuator 46. In the mean time, other sections included in the main body of the heater unit 10 are heated by the radiant heat radiated
10 from the radiant heating sections 24 and contained within the main body of the heater unit 10. Here, the wall of each of the recessed portions 20 is also made of a stainless plate, forming a part of the radiant heating section 24. This allows the diaphragm case 44 and the like accommodated in the recessed portions 20 to be heated
15 effectively. Through the operation of the heater unit 10 in the manner as described above, the pair of joints 50 and the entire flow path within the valve 40 are heated integrally and uniformly. In this way, formation of dew condensation and development of accretion are prevented in the entire flow path.

20 The heater unit 10 of the present embodiment is designed for a two-way valve. Various modifications and variations will be readily apparent to those skilled in the art by referencing the description above, including adaptation for a three-way valve application and the like.

25 The embodiment of the present invention has been described in detail. It should be understood that the description of the embodiment is illustrative of the present invention. Accordingly, the technical scope of the present invention should be defined only by the appended claims.